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Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new non-provisional applications under 37 C.F.R. §1.53(b))

Attorney Docket No.	9234
First Inventor or Application Identifier	O'Brien et al
Title	Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern Dental Prosthesis Made Thereby
Express Mail Label No.	EL584205747US

09/06/00
JC619 U.S. PRO
09/06/00

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO:

Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

- ☒ Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)
- ☒ Specification (Total Pages 15)
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure
- ☒ Drawing(s) (35 U.S.C. 113) (Total Sheets 3)
- ☒ Oath or Declaration (Total Pages 3)
 - ☒ Newly executed (original copy)
 - ☐ Copy from a prior application 37 C.F.R. § 1.63(d)
(for continuation/divisional with Box 16 completed)
 - ☐ **DELETION OF INVENTOR(S)**
Signed statement attached deleting
Inventor(s) named in the prior application,
See 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

*NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. §1.27), EXCEPT IF ONE FILE IN A PRIOR APPLICATION IS RELIED UPON 37 C.F.R. § 1.28)

- ☐ Microfiche Computer Program (Appendix)
- Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 - ☐ Computer Readable Copy
 - ☐ Paper Copy (identical to computer copy)
 - ☐ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

- ☒ Assignment Papers (cover sheet & document(s))
- ☐ 37 C.F.R. § 3.73(b) Statement ☒ Power of Attorney
(when there is an assignee)
- ☐ English Translation Document (if applicable)
- ☐ Information Disclosure ☐ Copies if IDS Citations
- ☐ Preliminary Amendment
- ☒ Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
- ☒ *Small Entity Statement(s) ☐ Statement filed in prior application,
(PTO/SB/09-12) Status still proper and desired
- ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)
- ☐ Other:

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) ☐ of prior application No: ____/
Prior application information: ____ Examiner: ____ Group/Art Unit:


FOR CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporate can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE

☒ Customer Number or Bar Code Label **21905** and ☐ Correspondence address below

PATENT TRADEMARK OFFICE

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Name	Connors & Associates				
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Name (Print/Type)	John J. Connors	Registration No. (Attorney/Agent)	24157
Signature		Date	Sept 6, 2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

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FEE TRANSMITTAL for FY 2000

Patent fees are subject to annual revision.

Small Entity payments must be supported by a small entity statement,
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See 37 C.F.R. §§ 1.27 and 1.28

Complete if Known

Application Number

Filing Date

First Named Inventor O'Brien et al

Examiner Name

Group/Art Unit

Attorney Docket No. 9234

TOTAL AMOUNT OF PAYMENT \$675.00

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any over payment to:

Deposit Account Number 03-2830

Deposit Account Name CONNORS & ASSOCIATES

- ☒ Charge Any Additional Fee Required
Under 37 CR 1.16 ad 1.17

2. ☒ Payment Enclosed:

☒ Check ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Small Entity

Fee Code	Fee (\$)	Fee Code	Fee (\$)	Fee Description	FEE PAID
101	690	201	345	Utility Filing Fee	\$605.00
106	310	206	155	Design Filing Fee	
107	480	207	240	Plant Filing Fee	
108	690	208	345	Reissue Filing Fee	
114	150	214	75	Provisional Filing Fee	

SUBTOTAL (1) (\$ 605.00)

2. EXTRA CLAIM FEES

Total Claims	Independent Claims	Multiple Dependent Claims	Fee from	FEE PAID
14	4		0	0
			30.00	30.00

**or number previously paid; For Reissues, see below

Large Entity Fee Code	Small Entity Fee Code	Fee (\$)	Fee (\$)	Fee Description
103	203	18	9	Claims in excess o 20
102	202	78	39	Independent claims in excess of 3
104	204	260	130	Multiple independent claim if not paid
109	209	78	39	**Reissue independent claims over original patent
110	210	18	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ 30.00)

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Fee Code	Entity Fee (\$)	Small Fee Code	Entity Fee (\$)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	1,840*	113	1,840*	Requesting publication of SIR prior to Examiner action	
113	2,520	147	2,520	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an Appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	40.00
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	760	246	380	Filing a submission after final rejection (37 CR 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CR 1.129(b))	

Other fee (specify)

Other fee (specify)

* Reduced by Basic Filing Fee Paid SUBTOTAL (3) (\$ 40.00)

SUBMITTED BY

Complete (if applicable)

Name (Print/Type)

John J. Connors

Registration No.
(Attorney/Agent)

24,157

Telephone

(949) 833-3622

Signature

Date

Sept 6, 2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
EXPRESS MAIL CERTIFICATION



APPLICANT : O'Brien et al
TITLE : DENTAL PROSTHESIS MANUFACTURING PROCESS,
DENTAL PROSTHESIS PATTERN & DENTAL PROSTHESIS
MADE THEREBY

DOCKET NO : 9234
CUSTOMER NO.: 21905

CERTIFICATE OF EXPRESS MAILING

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EXPRESS MAIL CERTIFICATE NO.: EL584205747US

By:

Linda Simpson

Date:

Sept. 6, 2000

AUTHORIZATION TO CHARGE/CREDIT DEPOSIT ACCOUNT

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By:

Barth Ellison

Date:

Sept. 6, 2000

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**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(b))-INDEPENDENT INVENTOR**

Docket Number (Optional)
9234

Applicant, Patentee, or Identifier: O'Brien et al

Application or Patent No.: _____

Filed or Issued: _____

Title: Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern & Dental Prosthesis Made Thereby

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below

- ☐ No such person, concern, or organization exists.
☒ Each such person, concern, or organization is listed below.

O'Brien Dental Lab, Inc.. State Of Incorporation: Oregon

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying , or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is not long appropriate. (37 CFR 1.28(b))

Michael J. O'Brien

NAME OF INVENTOR

NAME OF INVENTOR

NAME OF INVENTOR

Michael J. O'Brien

Signature of inventor

Signature of inventor

Signature of inventor

9/5/00

Date

Date

Date

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**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(b))-INDEPENDENT INVENTOR**

Docket Number (Optional)
9234

Applicant, Patentee, or Identifier: O'Brien et al

Application or Patent No.: _____

Filed or Issued: _____

Title: Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern & Dental Prosthesis Made Thereby

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

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Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below

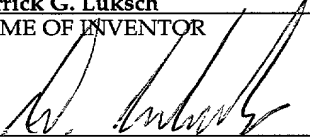
- ☒ No such person, concern, or organization exists.
☒ Each such person, concern, or organization is listed below.

O'Brien Dental Lab, Inc. State Of Incorporation, Oregon

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

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Derrick G. Luksch
NAME OF INVENTOR


Signature of inventor

9-5-00
Date

NAME OF INVENTOR

Signature of inventor

Date

NAME OF INVENTOR

Signature of inventor

Date

**STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c))-SMALL BUSINESS CONCERN**

Docket Number (Optional)

9234Applicant, Patentee, or Identifier: O'Brien et al

Application or Patent No.: _____

Filed or Issued: _____

Title: Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern & Dental Prosthesis Made Thereby

I hereby state that I am

- ☐ the owner of the small business concern identified below:
- ☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN O'Brien Dental Lab, Inc.ADDRESS OF SMALL BUSINESS CONCERN 4311 SW Research Way, Corvallis, OR 97333

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
- ☐ the application identified above.
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If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having rights in the invention is listed below

- ☒ No such person, concern, or organization exists.
- ☐ Each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING Michael J. O'BrienTITLE OF PERSON IF OTHER THAN OWNER President, O'Brien Dental Lab, Inc.ADDRESS OF PERSON SIGNING 4311 SW Research Way, Corvallis, OR 97333SIGNATURE *Michael J. O'Brien*DATE 9/5/00

1 **DENTAL PROSTHESIS MANUFACTURING PROCESS, DENTAL**
2 **PROSTHESIS PATTERN & DENTAL PROSTHESIS MADE THEREBY**

3
4 **BACKGROUND OF THE INVENTION**

5
6 Computer technology has advanced to the point where a dental
7 prosthesis may be milled from a solid block of material based on three-
8 dimensional digital data corresponding to a proposed shape of the
9 dental prosthesis. The dentist first makes an impression of a patient's
10 existing dentition. Typically, this includes nearby surfaces where the
11 prosthesis is to be located in the patient's mouth. This is accomplished
12 by the dentist first drilling away any unwanted dental tooth structure
13 and then having the patient bite into an impression material that forms
14 a negative impression of the patient's dentition, including the tooth
15 structure to which the dental prosthesis is to be attached. This negative
16 impression is then filled with dental die stone to make a model of the
17 tooth structure to which the dental prosthesis is to be attached and
18 adjacent teeth, particularly the teeth immediately above and to the
19 sides of the tooth structure to which the dental prosthesis is to be
20 attached. This model of the patient's dentition captures an impression of
21 the occlusion surfaces between upper and lower aligned teeth and the
22 configuration of the tooth structure to which the dental prosthesis is to
23 be attached.

24 The computer aided design equipment used to make a dental
25 prosthesis has ^a(an) scanner that is used to scan the surfaces of the model.
26 Scanning may be accomplished either with optical techniques using
27 laser or non-laser light or tactile techniques where a probe physically
28 contacts the tooth's surface. The computer aided design equipment
29 converts the model's surfaces into three-dimensional digital data
30 corresponding to the physical shape of the model. This original data

1 collected during scanning is then used to create an image of the
2 proposed shape for the prosthesis on a screen of a computer monitor.
3 The computer aided design equipment is programmed to allow the user,
4 with the aid of a mouse and employing conventional point and click
5 techniques, to change the shape of the image. The original image
6 displayed on the monitor screen needs to be adjusted to modify the
7 original image to correspond to the ultimate shape of the dental
8 prosthesis.

9 Because the data originally collected during scanning isn't precise
10 enough to make the dental prosthesis directly based on this data, the
11 user can and does make adjustments to the data originally provided by
12 the scanner so that the dental prosthesis, at least in theory, fits properly
13 into the patient's mouth. After making such adjustments to the data
14 collected by the scanner, the adjusted three-dimensional digital data is
15 then forwarded to an automatic milling machine which then mills away
16 the unwanted material from a block to form the dental prosthesis.
17 Typically, the block of material is a ceramic, titanium, or composite
18 plastic material. One of the perceived advantages of this technique is
19 the elimination of conventional investment casting of a wax pattern of
20 the dental prosthesis, which has conventionally been used to make a
21 dental prosthesis.

22 Although this computer aided design equipment proposes to
23 eliminate conventional investment casting, it suffers from a number of
24 drawbacks that prevent greater utilization of this technology. First, it is
25 impractical to make dental prosthesis from such precious metals as gold
26 and platinum using this technology because so much of the precious
27 metal is lost during the milling process. Second, the adjustments made
28 to the image based on the original data collected during scanning
29 usually fail to create a dental prosthesis that properly fits into the
30 patient's mouth. The inaccuracies in the shape of the dental prosthesis

1 so produced using this technology are particularly acute along the
2 marginal edges of the prosthesis adjacent the margins where the treated
3 (drilled) tooth surfaces of an individual tooth are contiguous with the
4 untreated (undrilled) tooth surfaces of this individual tooth.

5 6 SUMMARY OF THE INVENTION

7
8 This invention overcomes the drawbacks associated with the
9 computer aided design technology that eliminates investment casting of
10 a dental prosthesis and directly mills the prosthesis from a block of
11 material. It has several features, no single one of which is solely
12 responsible for its desirable attributes. Without limiting the scope of
13 this invention as expressed by the claims that follow, its more
14 prominent features will now be discussed briefly. After considering this
15 discussion, and particularly after reading the section entitled,
16 "DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT," one will
17 understand how the features of this invention provide its benefits,
18 which include, but are not limited to,

19 (1) usage of precious metal in making a dental prosthesis with
20 minimum waste of such metal,

21 (2) improved accuracy of the marginal edges of the dental
22 prosthesis positioned along the margins of a tooth structure, and

23 (3) reduction of time to make a dental prosthesis using
24 conventional investment casting techniques.

25 The invention includes a method of manufacturing a pattern of a
26 dental prosthesis from a wax material, a method of manufacturing a
27 dental prosthesis itself using this pattern, the dental prosthesis itself,
28 and the pattern used in the manufacture of the dental prosthesis. As
29 used herein, a dental prosthesis includes wax-ups (a term used in the
30 industry) of articulated jaws. These wax-ups constitute an entire array

1 of the teeth in an individual patient and they are used for diagnostic
2 purposes. As used herein, "wax material" includes waxes,
3 thermoplastics, combinations of wax and thermoplastic, or other
4 ablative materials that are commonly used in the lost wax process.

5 The first step of the method of this invention is to form a model of
6 a patient's dentition. This model includes surfaces corresponding to the
7 dental structure nearby the location that the dental prosthesis is to be
8 placed in the mouth of a patient.

9 The second step is to create three dimensional digital data
10 corresponding to these surfaces, and based at least in part on this data,
11 to create three dimensional digital data substantially corresponding to
12 the dental prosthesis to be manufactured. Typically this is
13 accomplished using a scanner to scan the surfaces of the model to collect
14 three dimensional digital data corresponding to these surfaces. A
15 monitor screen of computer aided design equipment displays an image
16 of a proposed dental prosthesis based, at least in part, on the collected
17 three dimensional digital data corresponding to the surfaces of the
18 model. With the aid of the computer aided design equipment, the image
19 is modified so that the modified image displayed on the monitor screen
20 substantially corresponds to the dental prosthesis to be manufactured.

21 The third step is to transmit the three dimensional digital data of
22 the dental prosthesis to be manufactured to automated prototyping
23 equipment. Using the automated prototyping equipment, a wax pattern
24 of the dental prosthesis is made from a wax material. This pattern is
25 then used in the lost wax investment casting process to manufacture the
26 dental prosthesis.

27 In accordance with this invention, the pattern has marginal edges
28 that are at least 3/4 of a millimeter from margins of an individual tooth
29 structure to which the dental prosthesis is to be attached. These set
30 back marginal edges of the pattern are manually adjusted to

1 compensate for the specific configuration of the individual tooth
2 structure by adding wax material to these set back marginal edges. This
3 insures that the inaccuracies ordinarily occurring using computer aided
4 design and milling equipment are avoided.

5 6 DESCRIPTION OF THE DRAWING

7
8 The preferred embodiment of this invention, illustrating all its
9 features, will now be discussed in detail. This embodiment depicts the
10 novel and non-obvious method of manufacturing a pattern of a dental
11 prosthesis from a thermoplastic material, and pattern and dental
12 prosthesis made by this method, as shown in the accompanying
13 drawing, which is for illustrative purposes only. This drawing includes
14 the following figures (Figs.), with like numerals indicating like parts:

15
16 Fig. 1 is a perspective view of the upper jaw portion of a model for
17 a patient's dentition.

18 Fig. 1A is an enlarged fragmentary view of part of the upper jaw
19 portion of the model for a patient's dentition shown in Fig. 1, depicting a
20 stump on which a crown type dental prosthesis is to be attached.

21 Fig. 2 is the monitor screen of computer aided design equipment
22 programmed to create images of different shaped dental prosthesis.

23 Fig. 3 is the monitor screen of computer aided design equipment
24 displaying how different portions of an image of a dental prosthesis
25 may be modified.

26 Fig. 4 is another view of the monitor screen showing a dental
27 prosthesis mounted to a tooth structure.

28 Fig. 5 is a schematic diagram of computer aided design equipment
29 used in the method of this invention.

1 Fig. 6 is a side elevational view of a treated tooth structure to
2 which a crown type dental prosthesis is to be attached.

3 Fig. 7 is a schematic diagram of computer aided design equipment
4 connected to automated prototyping equipment that makes a pattern
5 (referred to herein as wax pattern) of the dental prosthesis from wax
6 material.

7 Fig. 8 is a schematic cross-sectional view showing a wax pattern of
8 a crown type dental prosthesis positioned in a casting ring used in
9 investment casting.

10 11 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

12
13 In accordance with conventional techniques, a model of a patient's
14 dentition is made. The upper jaw portion 10 of such a model is shown
15 in Fig. 1. A lower jaw portion of this model is also used to collect tooth
16 surface data, but is not shown. For purposes of illustration as shown in
17 Fig. 6, an actual stump 32 to which a crown type 50a dental prosthesis
18 is to be attached includes a drilled away portion 32a and an
19 undisturbed portion 32b next to the patient's gum 34. Where the
20 contiguous borders of the portions 32a and 32b meet, as defined by the
21 line 38, a margin is formed. The jaw portion 10 includes a replicate 32a
22 of the stump 32 to which the crown type dental prosthesis 50a is to be
23 attached.

24 As shown in Fig. 6, computer aided design equipment 19 creates
25 an image of a dental prosthesis based on data collected from the model
26 of the patient's dentition. As illustrated in Fig. 7, computer aided design
27 equipment sold under the trademark LabQraft™ by Dentalmatic
28 Technologies, Inc. of St. Laurent, Quebec, Canada is modified in
29 accordance with this invention to eliminate milling apparatus connected
30 to an output 19a. In accordance with this invention, this output 19a is

1 connected to automated prototyping equipment 23. Other similar type
2 equipment such as sold by Decim AB of Skelleftea, Sweden, may also be
3 modified by eliminating the milling equipment and used in accordance
4 with this invention. Suitable automated prototyping equipment 23 is
5 sold under the trademark ModelMaker II™ by Sanders Prototype, Inc. of
6 Merrimack, New Hampshire.

7 The equipment 19 includes an optical scanner 20 that scans the
8 surfaces of the model of a patient's dentition by directing a beam of
9 light from a source 17 at the model's surfaces, for example, at the tooth
10 surfaces of the upper jaw portion 10. The reflected light represents
11 information corresponding to the contours of these surfaces. This
12 information is collected by a sensor 15 and then stored in the memory
13 22 of a computer 24 as three dimensional digital data. Various images
14 of a dental prosthesis are displayed on a screen 18 of a monitor 30
15 connected to an output 32 of the computer 24 based on the data
16 originally collected by the scanner 20. These images, and the
17 corresponding data creating these images, are modified by the user
18 using conventional input devices such as a mouse 26 and keyboard 28
19 to interact with, and modify, the originally collected three dimensional
20 digital data.

21 The numeral 12 is an image displayed on the screen 18
22 corresponding to the actual tooth structure, that is, the stump 32 (Fig. 6)
23 that has been prepared by a dentist for a dental prosthesis. The image
24 12 is created upon optically scanning the surface of the replicate 32a of
25 the stump 32 and manipulating the collected information of the surface
26 contours, creating the image 12 in accordance with a program 24a that
27 controls processing of the data by the computer 24. As depicted in Fig.
28 3 and 4, an image 14 of the crown 50a to be attached to the stump 32 is
29 displayed on the monitor's screen 18. In this example, an image 40 of
30 the surface of an upper tooth immediately above and facing the stump

1 32 and an image 42 of the surface of the upper adjacent tooth are also
2 displayed on the monitor's screen 18. Through the use of the mouse 26
3 and keyboard 28 the user can change parameters such as die spacer,
4 minimum thickness of the prosthesis, contact points, grooves, cusp
5 overlays and marginal ridges.

6 In accordance with this invention, the automated prototyping
7 equipment 23 makes a wax pattern 50 (Figs. 7 and 8) from wax
8 material. This wax pattern 50 is based on the data collected during
9 optical scanning. Typically, the pattern 50 is formed by a series of wax
10 layers laid one upon another until the desired overall shape is
11 completed. The wax pattern 50 formed by the method of this invention
12 is at least 3/4 millimeters from the margin line 38a corresponding to
13 the actual margin line 38 as determined when the pattern 50 is seated
14 by a dental technician on the replicate 32a of a stump 32. In other
15 words, when the user is creating on the monitor screen 18 an image 14
16 of the crown 50a, the edges 14a of this image 14 are at least 3/4 of a
17 millimeter from an image 38a of the margin line displayed on the
18 screen 18. Consequently, the wax pattern 50 has marginal edges 51
19 that are displaced at least 3/4 millimeters from the margin line 38a on
20 the replicate 32a that correspond to the actual margin line 38. In
21 accordance with this invention, the edges 51 of the pattern 50 are then
22 manually adjusted to compensate for the specific configuration of the
23 stump 32 by adding a wax material to these edges. This avoids the
24 inaccuracies associated with attempting to make a dental prosthesis that
25 fits properly based solely on computer manipulation of data and then
26 milling the prosthesis from a block of material as dictated by this data.

27 The wax pattern 50 produced by the automated prototyping
28 equipment 23 is used in the conventional investment casting process to
29 make the crown type dental prosthesis 50a. As shown in Fig. 8, the wax
30 pattern 50 is attached to a sprue 60 made of wax material. This sprue

1 60 is mounted to a raised conical portion of a rubber base 62 and a
2 metal ring 64 lined with a sheet 68 of ceramic fiber paper is seated on
3 the base. Preferably, a wax rod 70 extends from a side portion of the
4 pattern 50 to the base 62. The hollow interior 64a of the ring 64 and
5 base 62 is then filled with the investment material, for example, a
6 plaster, that is allowed to dry. After drying the assembly of the base
7 62, ring 64 and mounted wax pattern 50 is inverted and the base
8 removed. The sprue 60 and wax pattern 50 are next removed by
9 burning them away so that the casting is formed with a hollow cavity
10 (not shown) into which molten metal is poured to form the crown 50a.

11 12 SCOPE OF THE INVENTION

13
14 The above presents a description of the best mode contemplated
15 of carrying out the present invention, and of the manner and process of
16 making and using it, in such full, clear, concise, and exact terms as to
17 enable any person skilled in the art to which it pertains to make and
18 use this invention. This invention is, however, susceptible to
19 modifications and alternate constructions from that discussed above
20 which are fully equivalent. For example, although only crowns have
21 been illustrated, other dental prosthesis such as, for example, bridges
22 and inlays can be made using this invention. Moreover, this method
23 may also be used to make wax-ups of articulated jaws used for
24 diagnostic purposes. Consequently, it is not the intention to limit this
25 invention to the particular embodiment disclosed. On the contrary, the
26 intention is to cover all modifications and alternate constructions coming
27 within the spirit and scope of the invention as generally expressed by
28 the following claims, which particularly point out and distinctly claim
29 the subject matter of the invention:

THE CLAIMS

1. A method of manufacturing a pattern of a dental prosthesis from a wax material, comprising the steps of

(a) forming a model of a patient's dentition including surfaces corresponding to the dental structure nearby the location that the dental prosthesis is to be placed in the mouth of a patient,

(b) scanning said surfaces of the model to collect three dimensional digital data corresponding to the said surfaces,

(c) displaying on a monitor screen of computer aided design equipment an image of a proposed dental prosthesis based, at least in part, on the collected three dimensional digital data corresponding to said surfaces,

(d) with the aid of said computer aided design equipment, modifying said image so that said image displayed on the monitor screen substantially corresponds to the dental prosthesis to be manufactured,

(e) collecting the three dimensional digital data substantially corresponding to said image of said dental prosthesis to be manufactured and transmitting said three dimensional digital data of said image of said dental prosthesis to be manufactured to automated prototyping equipment,

(f) using the automated prototyping equipment making from a wax material the pattern of said dental prosthesis to be manufactured based upon said three dimensional digital data substantially corresponding to said image of said dental prosthesis to be manufactured.

1 2. The method of Claim 1 where the pattern has marginal edges that
2 are at least 3/4 of a millimeter from margins of an individual tooth
3 structure to which the dental prosthesis is to be attached.

4
5 3. The method of Claim 2 where, after step (f), the marginal edges of
6 the pattern are manually adjusted to compensate for the specific
7 configuration of said individual tooth structure by adding wax material
8 to said edges.

9
10 4. A method of manufacturing a dental prosthesis, comprising the
11 steps of

12 (a) forming a model of a patient's dentition including surfaces
13 corresponding to the dental structure nearby the location that the
14 dental prosthesis is to be placed in the mouth of a patient,

15 (b) scanning said surfaces of the model to collect three
16 dimensional digital data corresponding to the said surfaces,

17 (c) displaying on a monitor screen of computer aided design
18 equipment an image of a proposed dental prosthesis based, at least in
19 part, on the collected three dimensional digital data corresponding to
20 said surfaces,

21 (d) with the aid of said computer aided design equipment,
22 modifying said image so that said image displayed on the monitor
23 screen substantially corresponds to the dental prosthesis to be
24 manufactured,

25 (e) collecting the three dimensional digital data substantially
26 corresponding to said image of said dental prosthesis to be
27 manufactured and transmitting said three dimensional digital data of
28 said image of said dental prosthesis to be manufactured to automated
29 prototyping equipment,

1 (f) using the automated prototyping equipment making from a
2 wax material the pattern of said dental prosthesis to be manufactured
3 based upon said three dimensional digital data substantially
4 corresponding to said image of said dental prosthesis to be
5 manufactured, and

6 (g) using said pattern in the lost wax investment casting process
7 manufacturing said dental prosthesis.

8
9 5. The method of Claim 4 where the pattern has marginal edges that
10 are at least 3/4 of a millimeter from margins of an individual tooth
11 structure to which the dental prosthesis is to be attached.

12
13 6. The method of Claim 5 including, after step (f) and prior to step
14 (g), manually adjusting the marginal edges of the pattern to compensate
15 for the specific configuration of said individual tooth structure by
16 adding wax material to said edges.

17
18 7. A method of manufacturing a pattern of a dental prosthesis from a
19 wax material, comprising the steps of

20 (a) forming a model of a patient's dentition including surfaces
21 corresponding to the dental structure nearby the location that the
22 dental prosthesis is to be placed in the mouth of a patient,

23 (b) creating three dimensional digital data corresponding to the
24 said surfaces, and based on said data corresponding to the said surfaces,
25 creating three dimensional digital data substantially corresponding to
26 the dental prosthesis to be manufactured,

27 (c) transmitting said three dimensional digital data of said dental
28 prosthesis to be manufactured to automated prototyping equipment,
29 and

1 (d) using the automated prototyping equipment making from a
2 wax material the pattern of said dental prosthesis to be manufactured
3 based upon said three dimensional digital data of said dental prosthesis.
4

5 8. The method of Claim 7 where the pattern has marginal edges that
6 are at least 3/4 of a millimeter from margins of an individual tooth
7 structure to which the dental prosthesis is to be attached.
8

9 9. The method of Claim 8 where, after step (d), the marginal edges of
10 the pattern are manually adjusted to compensate for the specific
11 configuration of said individual tooth structure by adding wax material
12 to said edges.
13

14 10. A method of manufacturing a dental prosthesis, comprising the
15 steps of
16

17 (a) forming a model of a patient's bite registration including
18 surfaces corresponding to the dental structure nearby the location that
19 the dental prosthesis is to be placed in the mouth of a patient,
20

21 (b) creating three dimensional digital data corresponding to the
22 said surfaces, and based on said data corresponding to the said surfaces,
23 creating three dimensional digital data substantially corresponding to
24 the dental prosthesis to be manufactured,
25

26 (c) transmitting said three dimensional digital data of said dental
27 prosthesis to be manufactured to automated prototyping equipment,
28

29 (d) using the automated prototyping equipment making from a
30 wax material the pattern of said dental prosthesis to be manufactured
based upon said three dimensional digital data of said dental prosthesis,
and

(e) using said pattern in the ^{lost} wax investment casting process
manufacturing said dental prosthesis.

1
2 11. The method of Claim 10 where the pattern has marginal edges
3 that are at least 3/4 of a millimeter from margins of an individual tooth
4 structure to which the dental prosthesis is to be attached.

5
6 12. The method of Claim 11 including, after step (d) and prior to step
7 (e), manually adjusting the marginal edges of the pattern to compensate
8 for the specific configuration of said individual tooth structure by
9 adding wax material to said edges.

10
11 13. The pattern of a dental prosthesis made from a wax material in
12 accordance with the method of Claim 7.

13
14 14. The dental prosthesis made in accordance with the method of
15 Claim 10.

1
2 ABSTRACT OF THE DISCLOSURE

3
4 A dental prosthesis is made by first forming a model of a patient's
5 dentition. A three dimensional digital data corresponding to the
6 surfaces of the model is then created. Based on this data, a three
7 dimensional digital data file is then created substantially corresponding
8 to the dental prosthesis to be manufactured. The three dimensional
9 digital data of the dental prosthesis to be manufactured is next
10 transmitted to automated prototyping equipment, and using the
11 automated prototyping equipment, a wax pattern of the dental
12 prosthesis is manufactured based upon this three dimensional digital
13 data of the dental prosthesis. Finally, using this wax pattern in the lost
14 wax investment casting process, the dental prosthesis is made. Prior to
15 investment casting, marginal edges of the wax pattern are adjusted
16 manually.
17
18

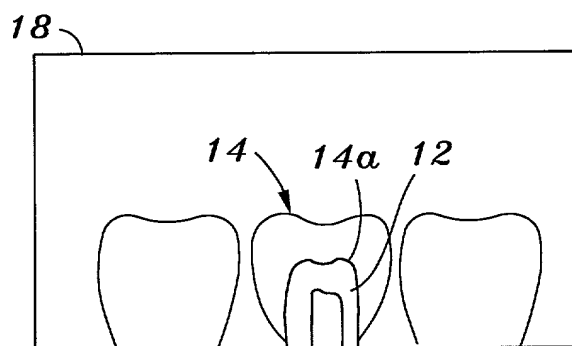
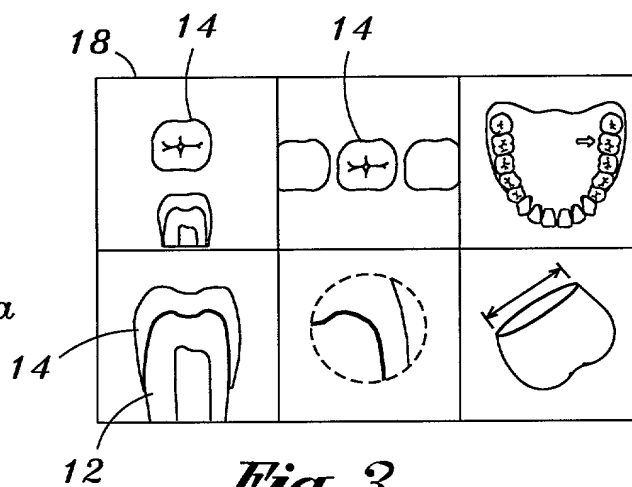
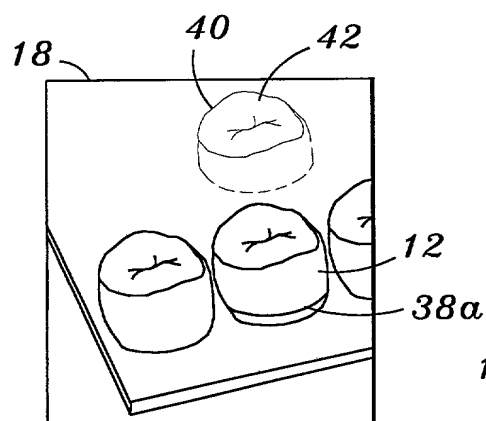
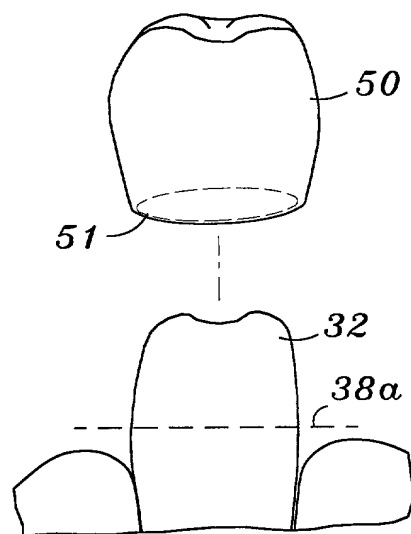
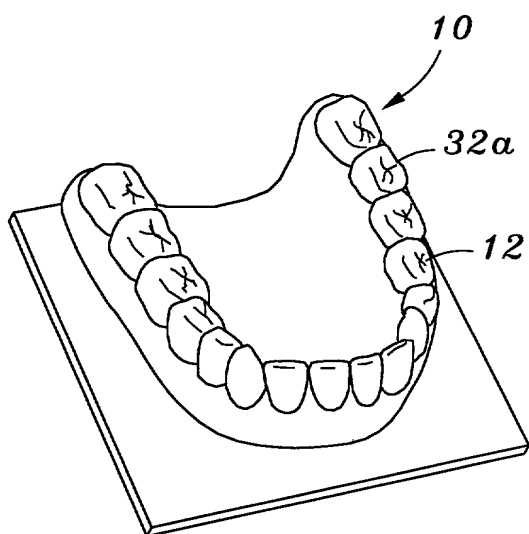


Fig. 5

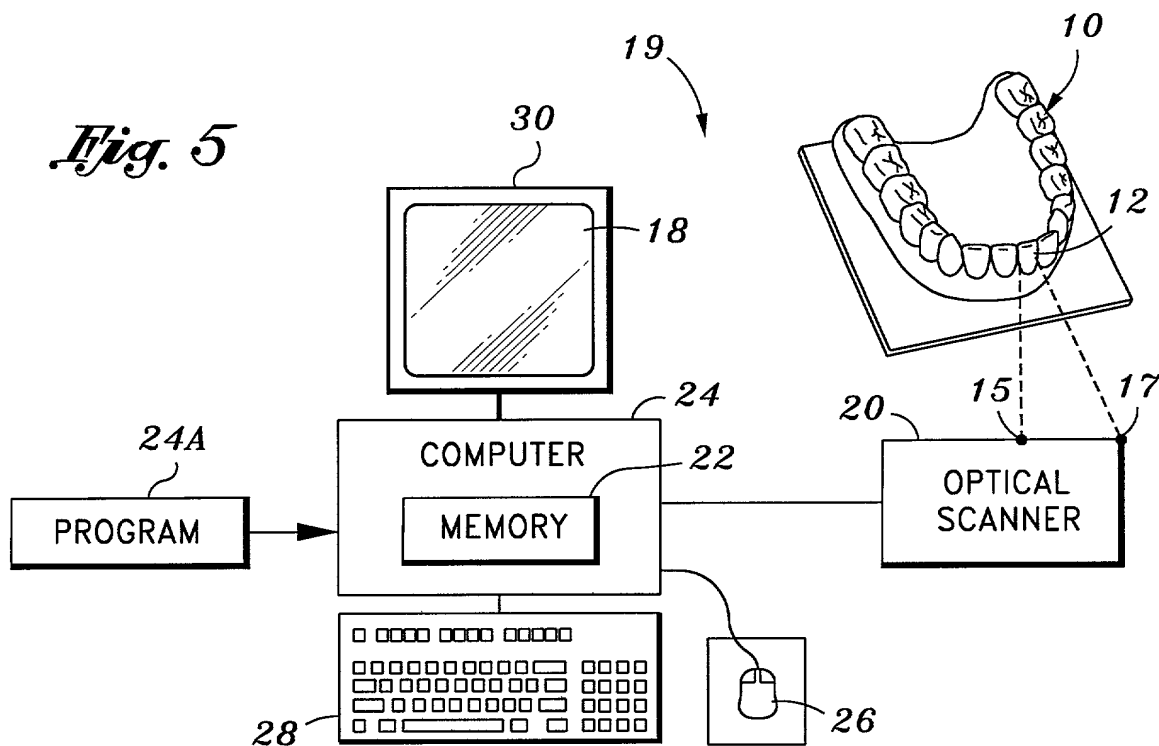


Fig. 6

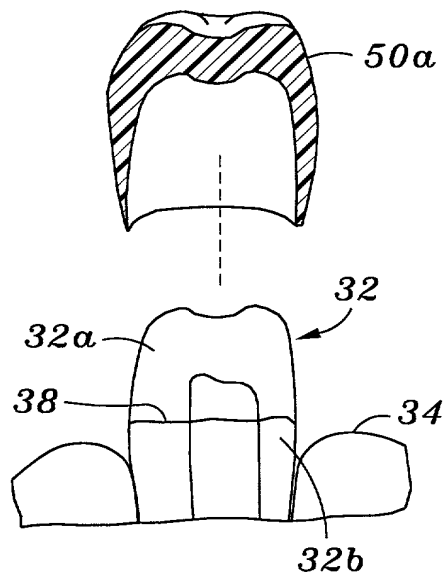


Fig. 7

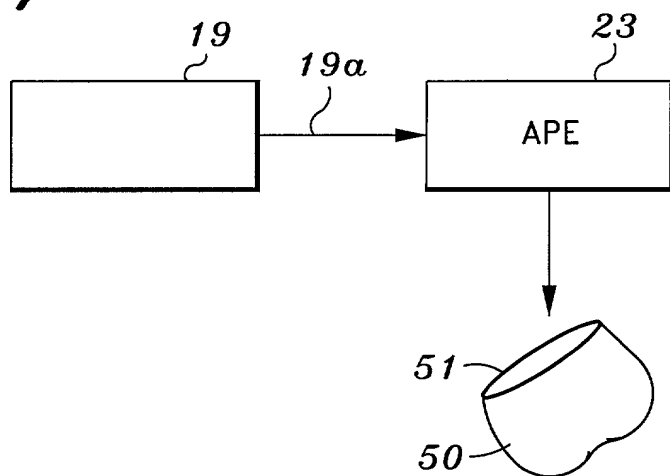
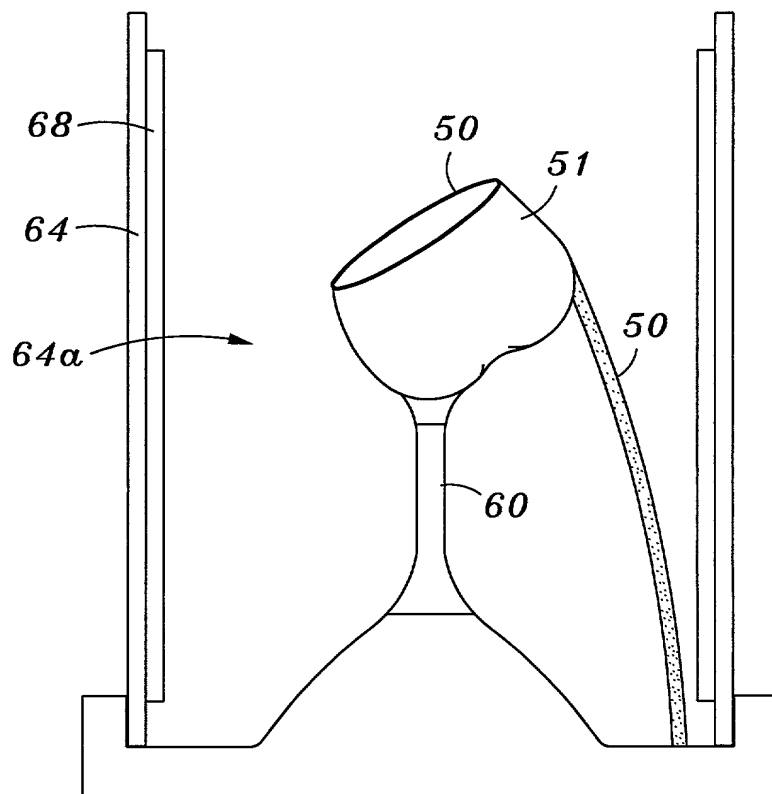


Fig. 8



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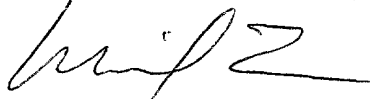
Assignee, O'Brien Dental Lab, Inc., hereby appoints John J. Connors to prosecute this patent application entitled **Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern & Dental Prosthesis Made Thereby** (Docket No. 9234), including the power to appoint, substitute, and terminate associate attorneys, and to transact all business in the United States Patent and Trademark Office in connection therewith. John J. Connors is a member of the Bar of the State of California, Patent Office Attorney Registration No. 24,157, whose address and telephone number is Connors & Associates, 1600 Dove Street, Suite 220, Newport Beach, CA 92660-2427, Telephone 949-833-3622, Facsimile 949-833-0885.

Dated : _____

9/5/00

ASSIGNEE: O'Brien Dental Lab, Inc.

By: _____



Michael J. O'Brien, President

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	First Named Inventor	O'Brien et al
	COMPLETE IF KNOWN	
	Application Number	
	Filing Date	
	Group Art Unit	
	Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**Dental Prosthesis Manufacturing Process, Dental Prosthesis Pattern & Dental Prosthesis
Made Thereby**

the specification of which

(Title of the Invention)

☒ is attached hereto

OR

☐ was filed on (MM/DD/YYYY) _____ as United States Application Number or PCT International Application Number _____ and was amended on (MM/DD/YYYY) _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of an PCT international application which designated at least one country other than the United States Of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

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			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application listed below.

Application Number (s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 1 of 2]

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U.S. Parent Application Number	PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT International application numbers are listed on a supplemental priority data sheet (PTO/SB/02B) attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith

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AND

☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

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PATENT TRADEMARK OFFICE

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor:		<input type="checkbox"/> A petition has been filed for this unsigned inventor					
Given Name (first and middle [if any])				Family Name or Surname			
Michael J.				O'Brien			
Inventor's Signature				Date	9/5/00		
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City	Corvallis	State	OR	ZIP	97333	Country	US

☒ Additional inventors are being named on the **3rd** supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto

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DECLARATION**ADDITIONAL INVENTOR(S)****Supplement Sheet**

Page 3 of 3

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